HERE IS THE TRUE STORY OF THE FAMOUS LIBERTY MOTOR

The Lightest and Most Powerful Airplane Engine in the World Is Now Being Produced on a Quantity Basis.

So many partisan stories have appeared reflecting on the Liberty Motor and those really responsible for its origin and development that the Automobile Department of THE SUN *is pleased to be able to reproduce "The True Story of the Liberty Motor" as written by a disinterested and accurate investigator of the* Scientific American.

The facts as he sets them down are those on which THE SUN *based its exclusive story weeks ago on the same subject.* THE AUTOMOBILE EDITOR.

WHEN Secretary Baker made the dramatic announcement last summer that a new motor christened the "Liberty" had been developed by two American engineers in a five day conference behind locked doors men who were experienced in machine design shrugged their shoulders. They knew the impossibility of designing so highly refined a machine as an airplane motor in such a brief time. They assumed, therefore, that the so-called new motor was probably a standard motor in which a few modifications had been introduced, and speculation was rife as to what particular standard motor had been adopted. It was at first claimed that the German motor, known as the Mercedes, formed the basis for the Liberty Motor; then other claimants came forward.

An air of mystery has surrounded the Liberty Motor from its inception, and it is high time that this was dispelled. Recent announcements from the War Department disclosing details of the motor and its similarity to other motors of American and foreign design give us the liberty to tell here for the first time the real story of the development of our standard aviation motor.

Shortly after the outbreak of the great European war Henry Joy, then president of the Packard Motor Car Company, became impressed with the importance of the airplane in modern warfare. He felt certain that before the conflict was over the United States would be involved, and looking about among our motor manufacturers he realised how poorly prepared we were to produce the motive power for aerial warfare. There was no question that Europe was far ahead of us in the construction of airplanes and airplane motors, and being a motor manufacturer himself he realised how long it would take to develop the manufacture of first class motors in this country, even after we woke up to the realisation of their necessity. Therefore he urged his company to proceed at once with the development of an airplane motor which would compare favorably with the very best produced in Europe. This was in the fall of 1914.

In the spring of 1915 work was started on such a motor, and the design was completed in November of that year. The engine was ready for block test in February of 1916. As there were no facilities for testing airplane engines by actual flights in this country, the new motor was placed in a racing chassis of special construction and was subjected to severe tests at the Sheepshead Bay Speedway. The engine was of 299 cubic inches displacement, or just under the 300 inch racing limit established by the A. A. A. It was of the twelve cylinder V type, with cast iron cylinders. After it had been thoroughly tested out a second model was designed based on the principles that had been proved out on the first model. This was of much larger design with four by six cylinders and of 965 cubic inches piston displacement. The new motor was provided with an airplane propeller and mounted on a truck. With this unique power plant the truck was driven about the streets of Detroit. The air propelled truck could travel faster than any man would dare to drive it. In one test the wheels were locked, and yet the truck was pushed over snow covered ground.

In April, 1917, a second engine of this model was completed and placed on a racing chassis. It established the official world's record of 130 miles an hour—or a mile in 28.76 seconds. In this second model steel forged cylinders were used, fitted with pressed steel jackets welded on. Considerable difficulty was at first experienced in attempting to weld the jacket to the cylinder without burning the metal or introducing strains in it. After considerable experiment it was found that the meeting edges which were to be welded must be of the same thickness otherwise the heavier section would carry off the greater proportion of heat and the two surfaces could not be heated to the same temperature. By reducing the surfaces to exactly the same section, welding with the oxy-acetylene torch was readily accomplished.

In the first models the cylinders were set at an angle of 60 degrees, following the practice used in automobile engines; but in the second model an angle of 45 degrees was adopted so as to cut down head resistance. Tests of the engine showed that there was no noticeable vibration with the cylinders set at this unusual angle, even when the engine was run at considerably reduced speed. In this engine the cam shaft was placed directly over the cylinders and the housing for the cam shaft acted as a truss to hold the upper ends of the cylinders rigid.

The third model was begun in April, 1917, immediately after war was declared, and the first engine was completed in May. This contained certain improvements over the previous models, aimed particularly at reduction of weight and simplification of manufacture.

One of the first demands upon this country when it entered the war was to start the manufacture of airplanes in large quantities. We had a reputation for manufacturing on a quantity basis, and it was felt that if we turned our great industrial organising ability upon this problem we could turn out a fleet of airplanes that would simply overwhelm the enemy. Our engineers had studied the foreign airplane motors and a number of them were being made in this country. It was realized, however, that they were not adapted for quantity production on an American basis, and it was very necessary for us to develop a motor of our own which would become a standard and which could be produced in enormous quantities. As soon as the United States was drawn into the war the Packard Motor Car Company offered its models and experience to the Government, and being actuated by patriotic motives was perfectly willing to abandon, for the time being, all claim to the origination of this motor, although it had expended $400,000 in its development. However, there were some changes that the Government called for, and it was felt that a representative of some other motor manufacturing concern should be called in to advise with the Packard engineers in the modifications which would eventually be adopted by the Government. Accordingly Major Hall of the Hall-Scott Motor Company was called to Washington to confer with Mr. (now Lieutenant-Colonel) Vincent, chief engineer of the Packard Company. Mr. Vincent had with him the blueprints of the complete plans of his motor, and these were studied by Major Hall, who suggested a number of changes.

When the war first broke out airplanes were fitted with 100 horse-power engines. Very soon they were found to be insufficient, and engines of 125 horse-power were made. The engine power then gradually increased to 150, 175, 200, and 250; and it was about in that neighborhood when Major Hall and Mr. Vincent were called upon to furnish the United States standard motor. It was felt that a motor should be designed so far ahead in power of anything else that had been produced that by the time it could be turned out in quantity it would still be well in the lead. Accordingly a horse-power of between 350 and 400 was sought, and the size of the cylinders was changed from 4x6 to 5x7. Because of the larger cylinders required in the new motor the angle of the V was changed from 40 to 45 degrees. The larger pistons and cylinders required slightly greater clearances. In place of the forced lubrication of the crank shaft which was provided in the Packard engine the scupper system was introduced by Major Hall, because it had been found very efficient on the Hall-Scott motor. This is also a feature of the Mercedes motor. The scupper consists of a small cuplike flange on the crank arm which catches the oil and throws it up on the bearing of the crank shaft. These and other slight modifications were thoroughly discussed and decided upon by the two motor experts, who worked unceasingly and arrived at the finished design in a conference lasting five days. They had a herculean task before them, and deserve the highest praise for the successful outcome of their efforts.

As soon as the conference was over telegraphic instructions were sent on to the Packard plant and work was started immediately upon the new motor. Even before blue prints arrived the wood model was prepared in the general form and essential features of the new motor. Work on the new engine was pushed at the highest speed possible, and on the third day of July it was completed and shipped to Washington. The next day it arrived there, on the nation's birthday, and was christened the "Liberty Motor."

After the first experimental motor had been completed it was subjected to a great many trying tests and was found to be exceedingly efficient and very light. It developed a horse-power of considerably over 400 and its weight was but little over 800 pounds. Its weight per horse-power was therefore about two pounds, which is much lighter than the majority of airplane motors. On endurance tests it stood up wonderfully. It was tested at the summit of Pike's Peak in order to determine its action under conditions of rarefied atmosphere, and proved very satisfactory. At the Bureau of Standards in Washington a special room was set aside in which a partial vacuum was created equivalent to that which exists at the maximum height to which an airplane engine has been carried. In this room the engine was found to operate perfectly. At one of its first altitude tests in a plane the American record for altitude was smashed. Not until September was the order to proceed with the manufacture of the Liberty Motor definitely given, and immediately work was started in the Packard plant.

It was not considered advisable to build a new plant and purchase new machinery for the manufacture of the new motor, because this would consume a great deal of time. Instead, it was decided to give up the manufacture of automobile motors for the time being and rearrange the machine tools to take the new motor. While the plans were being prepared to carry this out the automobile motor plant was operated day and night at full capacity in order to produce as many automobile motors as possible before the manufacture of them stopped. Under this intensive programme by the end of the year a large stock of motors had been machined and for the most part assembled to meet the commercial demands. In the meantime work on the new Liberty Motor was going ahead as fast as possible. New jigs had to be constructed, machine tools had to be fitted with new appliances and the work had to be organised so that the motor could be produced on a large scale.

It is interesting to note that the first experimental motor was delivered to the Government on the Fourth of July, and the first production motor was sent to Washington on Thanksgiving Day. This, however, did not mean that the production problems had all been solved. No one except a man who has actually had experience with such work can realize the infinite amount of detail required in organizing a new industry. Usually the organisation work does not make any showing at all to the general public, and consequently is not appreciated. One of the engineers of the Ford plant told the writer personally that he thought every one would recognise the right of the Ford company to an opinion on quantity production manufacture. He said that never in the world's history had a greater piece of work been done on a similar scale. The development of the Liberty Motor was simply short of marvellous, and the public instead of criticising the manufacturers for slowness should be thankful that they have had such competent men to carry on the work and develop a motor of such efficiency in so incredibly short a space of time.

The motor which was delivered to the Government on Thanksgiving Day developed a number of small troubles. One of these was the difficulty of lubrication, and eventually it was found necessary to change the scupper system to the original forced lubrication system. But the most important change was made in the production of the cylinders. In the first Liberty Motors the cylinders had to be bored from the solid—an operation that was very costly in time and money. This, however, was a copy of the best foreign engineering practice, and was followed as a necessary detail by our engineers. It was at this juncture that the engineers of the Ford Motor Car Company made a notable contribution. They developed a cylinder forged out of steel tubing, which enabled the manufacturers to turn out the cylinders at very low cost and in exceedingly large quantities. Seamless steel tubing is used, and this in but four operations under the forge press and bulldozer is converted into a headed and flanged cylinder blank on which a minimum of machining need be done. The manufacture of these cylinders was not undertaken until the end of January, and now they are being turned out in very large quantity. Each week the cost of producing the cylinders has been reduced slightly, and all the savings made have been turned over to the Government. At the time the writer observed the work on these cylinders the cost had been cut down more than half, with even greater economies in prospect.

One of the difficulties encountered in the Liberty motor had to do with the form of ignition. In the original Packard motor the "Delco" system of ignition was used. This consists in generating current with a small electric generator geared to the engine shaft and then transmitting the current by means of a pair of distributers to the spark plugs. Magneto ignition was tried, but it proved impossible to design a single magneto which would operate with the irregular timing required in an engine in which the cylinders were set at the unusual angle of 45 degrees. A single magneto could not be used and so a battery of four magnetoes had to be employed. This added somewhat to the weight of the engine. Then further difficulties were encountered. Owing possibly to the vibration of the engine at high speed the magnets of the magneto showed fatigue and gradually lost their magnetic property. So that eventually it was decided to return again to the original system of ignition. One of the marked differences in appearance of the Liberty and Packard "900" is due to the fact that the latter is provided with reduction gearing. The advantage of this is that it places the hub of the propeller more nearly in line with the centre of area of the engine, so that far more efficient driving results are produced in the air. For this reason the reduction gearing is being looked upon with favor now, and it is highly probable that there will be a return to this feature of the original Packard "900." Furthermore the ideal speed for the engine is higher than ideal propeller speed. It is rather remarkable that in a number of very important features it has been necessary to revert to the original design.

Production of the Liberty motor is now proceeding at a very satisfactory pace. More motors are being produced than there are planes to carry them. When the writer visited the Packard plant several weeks ago they were being turned out at the rate of 15 per day and it was hoped that inside of two months a production of 50 per day would be attained. No expense was being spared to reach this rate of production, but again the matter of organisation was holding up the work so that it was considered impossible to attain that rate before the end of June.

In the Ford plant, manufacture of the Liberty motor was just about to start with a programme of 100 complete engines per day when the plant is in full operation. Here, as in the Packard plant, the standard equipment of the machine shop was being overhauled and reorganised for work on the Liberty motor. This was being done at the expense of the regular commercial motor. In several other factories work on the Liberty motor has just begun or is about to begin, and certainly by the middle of the summer the Liberty motor ought to be produced in very large quantities. The only thing that is retarding the airplane programme now is the manufacture of planes to carry the motors.

The efficiency of the Liberty motor is not to be questioned by any one who has examined it thoroughly. It is far more powerful than any other airplane engine ever produced on a quantity production basis. It exceeds in power all but a few experimental machines. Although rated at 400 horse-power it has shown on test as high as 485 horse-power and its weight is 820 pounds.

It is a mistake to assume that any one motor is adapted to all classes of airplane service. There is no single motor abroad which is of such universal utility. The Liberty motor is one of the most powerful airplane motors in the world and the lightest for its power. Obviously it would be impracticable to use it on light machines which do not require such power or on slow observation machines. But it is ideal for bombing purposes, for here we have large airplanes of great carrying capacity that must travel long distances at high speed. The Liberty motor should also be available for fighting machines of the larger types. We are making a great many motors of other types for our training machines and for our lighter fighting machines. Altogether the airplane situation is fast approaching a very satisfactory basis, and before the end of the year it should play an important part in the great struggle on the other side of the water.

MOTORS NOT MYSTERIOUS.

Many Find Driving Very Easy Task.

"I've heard many people say they would buy a car if they knew how to run it," says George Morrow, president of the Saxon Motor Company of New York, "yet it is such a simple proposition that it seems absurd to hear a big healthy man say it when he sees the streets full of cars driven by frail women and driven well. Of course I know how simple it is to drive a Saxon, but occasionally our salesmen have a hard time to convince a man he can learn not only to drive but to take care of his own car in a very short time. There is nothing intricate or mysterious about a motor—it is being simplified and standardized more and more every year, and I believe in a few years we will see standard parts interchangeable on all cars.

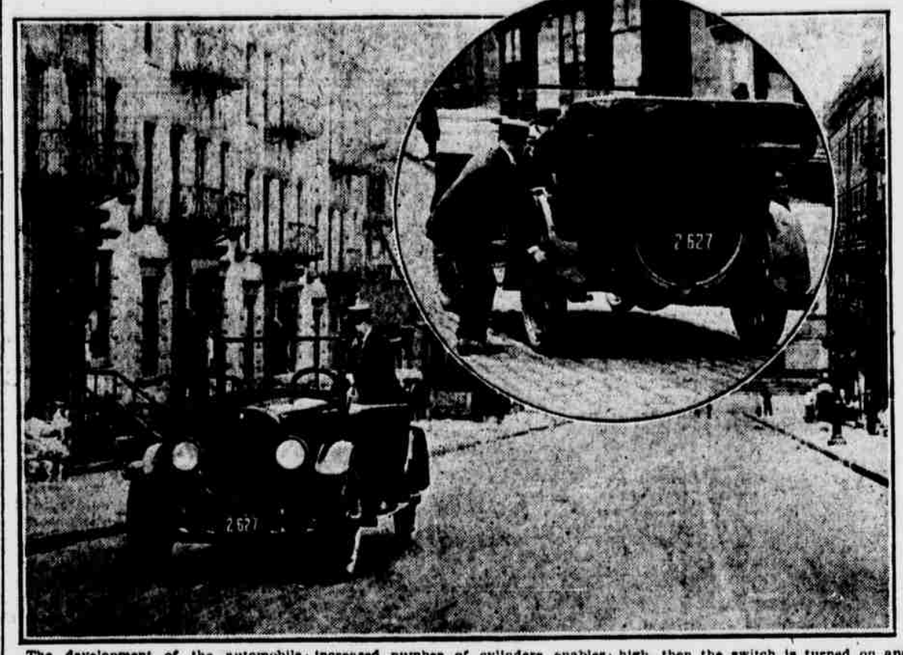
"Another thing that deters some men from learning is the price they have paid for their car and they are afraid to take chances. They have become so accustomed to leaning on some one else they lack self-reliance, but the time is coming, if it is not here now, when this must be changed. Take our Saxon car, for instance. It is a car any man, regardless of his financial standing, may be proud to drive. Its first cost is low, it is economical, the operation is so simple any one can drive it with a few lessons, and it's such a sturdy car the small upkeep cost is remarkable. One of the strongest features is the immense saving in tires and the big mileage obtained with the minimum of wear and tear."

Jepson Joins Hurlburt.

Frank Jepson, formerly manager of sales promotion of the Firestone Tire and Rubber Company of New York, has accepted the position of assistant sales manager of the Hurlburt Motor Truck Company, where he will be in charge of retail sales and sales promotion.

Mr. Jepson is comparatively a newcomer to the automobile field, but his rise has been rapid.

King Eight in Novel High Gear Demonstration.



The development of the automobile "demonstration" to prospective customers has undergone a remarkable change during the past few years, as motors have been made more flexible.

It used to be the fashion to rush a car up a hill as fast as possible, so that it would not "die" before the top was reached. Now it is quite the thing to show how slowly the car can make the ascent in high gear. The increased number of cylinders enables the modern automobile to perform feats at low speed in high gear that make the efforts of earlier days look feeble.

Now comes a new and unique demonstration developed by the King Car Corporation with its King Eight. The prospect is taken to the foot of the steep automobile test hill on Sixty-first street between Tenth and Eleventh avenues. The motor is brought to a complete stop with the gears left in high, then the switch is turned on and the demonstrator leaves the car and starts the motor by pulling the rear wheel over slightly.

The car immediately moves away in high gear, and the demonstrator, standing on the running board, guides it half way up the hill at two miles per hour. At the half way point he returns to his seat behind the wheel and accelerates until he is making twenty-five miles an hour at the top.

WHAT CONSTITUTES IDEAL MOTOR CAR

Dealer Strikes an Average in 1918 Engineering Practices and Appointments.

By SAMUEL SCHARY.

The successful automobile of to-day is the one that most closely conforms in appearance, performance and endurance with the ideal car of the master minds of the modern automobile world.

What this ideal is may be closely judged each year by a close study and analysis of the new models.

Every high grade car made in America can be included in these analyses. It was found that the average price of these cars was $1,950, which means that a car representing the average of these cars would sell at this price. This average car would have some of the features of the best cars and some of the features of the low priced cars, or would represent the medium between the two.

The ideal car is a car possessing all the features and characteristics that represent the best practices in automobile design and construction. Best practices are determined by the number of automobile builders adhering to those practices and by the trend in automobile design. The automobile has now reached a stage of perfection that all the best practices and features in design have been adopted by the majority of good cars, or the trend is toward the adoption of those features as shown by the annual changes in cars.

The following analyses are based on 170 different models of cars, or rather chassis, and include every well known make of car in America.

The comparison of the well known cars shows that 50 per cent. of the chassis are using six cylinder motors, a 3 per cent. gain over last year; 32 per cent. are equipped with four cylinder power plants and the number of makers using eight cylinder and twelve cylinder engines forms a small percentage of the total.

In 1916 44.7 per cent. were fours, 44.1 per cent. sixes, 11.6 per cent. were eights and 3-6 per cent. were twelves. In 1917 35.9 per cent. was fours, 47 per cent. were sixes, 13 per cent. were eights and 4.1 per cent. were twelves. In 1918 there are 33.3 per cent. fours, 50 per cent. sixes, 13.4 per cent. eights and 4.3 per cent. twelves.

The two year variation shows that the number of six cylinder motors are gaining faster than any other, contrary to the popular opinion. Many think the eight and twelve cylinder motors are gaining faster than the sixes, but they have made practically no gain at all during the last year. The number of six cylinder motors adopted has increased 3 per cent.

In the matter of cylinder design the L head block casting is used on the majority of motors; in fact, reports show that 67 per cent. of the total chassis are using this construction, as compared to only 23 per cent. using valve in the head motors; 6.3 per cent. use the T head and 3.5 per cent. use the sleeve motor.

The average motor cylinder bore of all the well known chassis has gradually increased in the last few years and now stands at 3.4 inches.

For two years the average length of stroke has been increasing, and the average of all the cars in 1918 is 4.9 inches. The "average" car for 1918 would therefore have a six cylinder 3.4 inch by 4.9 inch motor.

The combination of force feed and splash oiling system, insuring economical and positive lubrication, continues to lead the field, gaining 4.6 per cent. last year and now used in 59.8 per cent. of automobiles for 1918.

The use of helical gears for front and drive on the motor made a gain of 3.4 per cent., and 78 per cent. of all makes are using this drive. Silent chain drive made a small gain and spur gear drive is nearly obsolete.

For four years the use of the water circulating pump has been on the upward trend, with a resulting decrease in the use of the thermosiphon system of cooling. Last year's gain was 4½ per cent., and 68.1 per cent. of all the chassis now use the pump system.

Both pressure and gravity system of fuel feed lost in popularity last year, causing a gain of nearly 10 per cent. in the use of vacuum feed systems; 83.7 per cent. of all the chassis now use the vacuum system.

Battery distributer ignition made another gain of 5 per cent. as compared to magneto ignition and is now used on 77½ per cent. of all chassis.

Fifty-two and six-tenths per cent. of the total chassis have adopted the full Hotchkiss drive for 1918. This is a gain of 7.5 per cent. in the last year.

The rear spring suspension for 1918 is more nearly standardised than at any time in recent years. It is true that there are still no fewer than ten different types in use, but the semi-elliptic predominates the field, with an increase of 10 per cent. over 1917. In conclusion it is interesting to note how many features of the ideal car are embodied in the Case car of 1918.

31 MILES ON 1 GALLON OF GAS.

Moon Six Cylinder Car Makes Astonishing Record.

A record of 31.8 miles on one gallon of gasolene was made at Dallas, Texas, May 24, by a Moon 6-36 car, under the inspection of the automobile editor of the Dallas *Times-Herald* and another watcher.

The car was driven by A. H. Hardin of the Moon Automobile Company of Dallas and was one which had just been taken out of stock. A single gallon of gasolene in a sealed can was attached to the carbureter and all other gasolene drained from the main tank.

The car was driven at an average speed of 20 miles per hour and some of the roads over which it went were heavy with mud, but the little six did not falter once and as the last drop of gasolene in the gallon can went through the carbureter the speedometer registered 31.8.

This record is almost unequalled for a six cylinder car carrying three passengers.

CAR SHORTAGE IS SURELY IN SIGHT

Reo Manager Tells of Experience He Is Having With Dealers.

A large number of orders in excess of production received by the Reo Motor Car Company during the last few weeks justifies the recent prediction of James J. Hunt, manager of the Reo Motor Car Company of New York, that there would be a shortage of automobiles this spring.

Mr. Hunt says:

"Reo dealers are not only taking cars as fast as they are built, but they have exhausted the stock which accumulated during the winter months, when weather conditions interfered with transportation. And there is some indication of further curtailment of production in order that more Government work may be completed in the Reo factory.

"In one week recently the number of orders received by Reo was almost four times as great as the number of cars built. Practically all of the orders were placed, too, with the understanding that the cars would be driven overland to their destinations to relieve railroad traffic. Already many Reo dealers have taken their cars this way. They have thus rendered an important service to the nation by leaving whatever railroad capacity is available for the urgent transportation of Government supplies.

"The trend of conditions indicates that as the summer advances the shortage of motor cars will be more acute. A far larger percentage of production is sold than is customary at this time of the year."

Rainer Motor Truck Price Goes Up.

On June 1 the chassis price of the model R-4, 1¼ ton capacity, Rainer motor truck was advanced from $1,350 to $1,475.